

REMARKS

The Examiner has rejected claims 1, 35, 92, 94, 95 and 96 under 35 U.S.C. §102(b) as being anticipated by Yao et al. U.S. Patent No. 6,051,114 (hereinafter “Yao”). Claims 2, 3, 6, 7, 9-11, 13-20, 26-28, 30-33, 36-40 and 93 are rejected under 35 U.S.C. §103(a) as being unpatentable over Yao in view of Yasar et al. U.S. Patent Application Publication No. 2003/0034244 (hereinafter “Yasar”). Claims 12 and 29 are rejected under 35 U.S.C. §103(a) as being unpatentable over Yao in view of Yasar, as applied to claims 2, 3, 6, 7, 9-11, 13-20, 26-28, 30-33, 36-40 and 93 above, and further in view of Konishi et al. Japanese Patent No. 09-360040 (hereinafter “Konishi”). Claim 34 is rejected under 35 U.S.C. §103(a) as being unpatentable over Yao in view of Yasar, as applied to claims 2, 3, 6, 7, 9-11, 13-20, 26-28, 30-33, 36-40 and 93 above, and further in view of Gopalraja et al. U.S. Patent No. 6,274,008 (hereinafter “Gopalraja”). Claims 43, 45-49, 53-55, 57-59, 61, 62, 84 and 97 are rejected under 35 U.S.C. §103(a) as being unpatentable over Yasar. Claims 64, 67-70, 73, 74, 77-79, 81-83, and 85-89 are rejected under 35 U.S.C. §103(a) as being unpatentable over Yasar, as applied to claims 43, 45-49, 53-55, 57-59, 61, 62, 84 and 97 above, and further in view of Yao. Claims 60 and 80 are rejected under 35 U.S.C. §103(a) as being unpatentable over Yasar in view of Yao, as applied to claims 43, 45-49, 53-55, 57-59, 61, 62, 64, 67-70, 73, 74, 77-79, 81-89 and 97 above, and further in view of Konishi. Claim 63 is rejected under 35 U.S.C. §103(a) as being unpatentable over Yasar in view of Yao, as applied to claims 43, 45-49, 53-55, 57-59, 61, 62, 64, 67-70, 73, 74, 77-79, 81-89 and 97 above, and further in view of Gopalraja. The following remarks are respectfully submitted.

The Amendments

Yao states that it would be desirable to perform the deposition and etch simultaneously by adjusting sputtering power and bias to appropriate levels but does not disclose what parameter settings must be made to make simultaneous deposition and etch possible. (Yao Col. 6, Lines 23-27). Claims 1, 43, and 92 have been amended, and new claims 98-107 have been

added, to recite specific parameters that make the concept of simultaneous deposition and etching work.

35 U.S.C. §102 Rejection

The Examiner has maintained his rejection of independent claims 1 and 92 as anticipated by Yao. Applicants have amended these claims to state that the wafer table is cooled to a temperature of approximately -30° Celsius. This is not taught in Yao. Instead, Yao explicitly teaches that the support pedestal may be "heated by internal coils or the like...to increase the processing temperature." (Yao Col. 3, Lines 52-54).

Applicants respectfully submit that independent claims 1 and 92 should be allowed for at least the reasons provided above. Additionally, claims that are dependent on claims 1 and 92, which contain all of the elements of the independent claims therein, should also be allowed.

35 U.S.C. §103 Rejection: Yao in view of Yassar

The Examiner maintains his rejection of claims that are dependent on independent claims 1 and 92 as unpatentable over the combined teachings of Yao and Yassar. Yassar claims that the substrate is cooled to 0° Celsius. (Yassar Claim 11). Further, Yassar does not teach the depositing or etching, or combination thereof of material on the sidewall or bottom surface, or combination thereof. Therefore, Yassar does not cure the deficiencies of Yao and these dependent claims should be allowed.

35 U.S.C. §103 Rejection: Yao in view of Yassar and Konishi

Dependent claims 12 and 29 were specifically rejected as being unpatentable over the teachings of Yao in view of Yassar and further in view of Konishi. In that regard, the Examiner has noted that the combination of Yao and Yassar does not teach the use of a metal gas. (Office Action dated January 9, 2008, page 11). While the Examiner is correct in asserting that

Konishi teaches the use of an organometallic gas in the formation of a membrane during the CVD process, Konishi does not cure the deficiencies in the teachings of Yao and Yasar that are noted above. (Konishi ¶0033, machine translation). Further, it would be known that the class of organometallic gases does not encompass all metal-containing gases. Therefore, Applicants submit that claims 12 and 29 are allowable over the combination of art.

35 U.S.C. §103 Rejection: Yao in view of Yasar and Gopalraja

Claim 34 was specifically rejected under 35 U.S.C. §103(a) as being unpatentable over Yao in view of Yasar and further in view of Gopalraja. In that regard, the Examiner asserts that Gopalraja teaches punching through the bottom layer by etching through the barrier layer at the via bottom, which was not addressed in either Yao or Yasar. (Office Action dated January 9, 2008, page 11). However, Gopalraja does not teach an LND process as provided in Applicants' claims. Thus, Gopalraja does not cure the deficiencies of Yao and Yasar. Therefore, Applicants submit that claim 34 is allowable over this combination of art.

35 U.S.C. §103 Rejection: Yasar

The Examiner maintains his rejection of independent claim 43 as unpatentable over the teachings of Yasar. Yasar teaches a sequential deposition and etching process where material is first deposited and then etched from both the field area and the via bottom. (Yasar Col 2, Line 66 – Col. 3, Line10). Claim 43 has been amended in a manner similar to claim 1, and now states that the wafer table is cooled to a temperature of approximately -30°C. Additionally, claim 43 states the NND process step is performed by establishing a chamber pressure of 50-100 mTorr and an NND target power level of between 100 and 1500 w to deposit material on the sidewalls of the feature while depositing or etching, or a combination thereof, material from the field area or bottom surface, or a combination thereof. This combination of chamber pressure and target power level operational ranges establishes the NND process where material is deposited onto the

sidewalls while material is deposited or etched, or a combination thereof, from the field or the bottom surface, or a combination thereof. Unlike Yasar, etching is occurring simultaneously with the depositing at chamber pressures that are much greater than 2 mTorr (see Yasar TABLE II in Column 6).

Applicants respectfully submit that, for at least these reasons, claims 43 and 103 should be allowed. Additionally, claims that are dependent on claims 43 and 103, which contain all of the elements of the independent claims therein, should also be allowed.

35 U.S.C. §103 Rejection: Yasar in view of Yao

Finally, the Examiner has rejected some of the claims that are dependent on claim 43 as unpatentable over the combined teachings of Yasar in view of Yao. While these claims should be allowed for at least the reasons provided above, Applicants will separately address the application of Yao to these claims.

Yao teaches a deposition process at chamber pressures of 0.1-5 mTorr. (Yao Col. 2, Lines 56-64; Col. 3, Lines 52-56; Col. 4, Lines 58-60; Claims 6, 7, 16, and 17). Yao explains that at pressures below 10 mTorr, ejected or sputtered atoms travel across the plasma without interaction. (Yao Col. 1, Lines 27-33). With the low chamber pressure set, Yao then utilizes a pulse DC power supply to reduce the sticking of metal ions to the field area of the substrate while material is deposited onto the walls of the trench or the hole. (Yao Col. 5, Lines 44-Col. 6, Line 2). As seen in FIG. 2, the high negative potential 200 of the DC waveform is applied to the target to accelerate deposition flux toward the substrate for depositing on the field and within the hole or trench and a slightly positive voltage 202 to remove charge buildup. (Yao FIG. 2; Col. 4, Lines 19-45). This slightly positive voltage of the DC waveform creates an intermittent etching of the field area. (Yao Col. 6, Lines 12-26). It is this DC waveform that allows the hole of the trench to become filled with the deposited material while preventing the deposition of metal on the field areas. (*Id.*).

By contrast, Applicants claim and teach high chamber pressures, in combination with target power (Claim 43) and the ICP power level (Claims 55-56) to achieve the low NND deposition rates while material is deposited and etched on the field area, or the bottom surface, or a combination thereof. Deposition while etching at high pressures are not taught in either of Yasar or Yao. Further, there would be no motivation to combine the high pressure deposition mode parameters of Yasar to the low pressure system taught in Yao to achieve simultaneous deposition and etching of the field and the bottom surface when etching has conventionally been achieved at low chamber pressures.

Applicants therefore respectfully submit that these dependent claims remain allowable over this combination of cited art.

New Claims

Applicants have introduced new independent claims 98 (LND) and 103 (NND) that include material similar to claims 1 and 43. Both claims 98 and 103 include that the processing chamber pressure is greater than approximately 20 mTorr and less than approximately 130 mTorr. As noted above, Yao is limited to chamber pressures of between 0.1 to 5 mTorr. (Col. 2, Lines 56-60; Col. 3, Lines 54-56; Claims 6, 7, 16, and 17). Additionally, Yasar is limited to high pressure for the only the deposition mode of the sequential process.

Claims 98 and 103 further include that the respective deposition rates are established by adjusting an ICP power level and a target power level to within the ranges provided. These combinations of parameters and ranges are not taught in either Yao or Yasar in order to achieve an LND or NND deposition rate. Further, these parameters are not taught in either reference when etching occurs.

Applicants respectfully submit that these new claims should be allowed over the cited art.

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Final Office Action mailed June 20, 2008

Conclusions

In view of the foregoing amendments to the claims and remarks given herein, Applicants respectfully believe this case is in condition for allowance and respectfully request allowance of the pending claims. If the Examiner believes any detailed language of the claims requires further discussion, the Examiner is respectfully asked to telephone the undersigned attorney so that the matter may be promptly resolved. The Examiner's prompt attention to this matter is appreciated.

Applicants are of the opinion that a two-month extension of time is due with this Amendment. Payment of all charges due for this filing is made on the attached Electronic Fee Sheet. If any additional charges or credits are necessary to complete this communication, please apply them to Deposit Account No. 23-3000.

Respectfully submitted,

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